



PLATES



Rationalised sizes of Plates from Plate Mill

Thickness (mm) \ Width (mm)	Length (mm)								
	1600	1800	2000	2200	2500	2600	2800	3000	3200
8						7000 9000 9300			
10					6300 9300 12500	6300 7000 9000 9300 12500			
12					6300 8000 9000 12500	6300 8000 9000 12500	6300 7000 9000 9300 12500		
14				9300	6300 7000 9000 9300 12500	6300 7000 9000 9300 12500	5600 6300 7100 8000 9000 12500		
16			7000 9300	6300 7000 9000 9300 12500	6300 8000 9000 9300 12500	6300 8000 9000 9300 12500	5600 7100 8000 8000 10000		
18		5600 7100 9300 12500	6300 7000 8000 9000 9300 12500	6300 8000 9000 12500	5600 7100 8000 8000 10000	5600 6300 7100 9300 10000	6300 9000 9300 10000		
20	7000 9300	6300 7000 8000 9000 9300 12500	5600 6300 8000 8000 9000 12500	5600 7100 8000 8000 10000	6300 7100 9000 9300 10000	6300 9000 9300 10000	5600 6300 8000 9000 9300		
22	6300 7000 9000 9300 12500	6300 8000 9000 12500	7100 8000 10000	6300 7100 9300 10000	5600 6300 8000 9000 9300	5600 6300 8000 9000 9300	5600 7100 8000		

Rationalised sizes of Plates from Plate Mill

Thickness (mm) \ Width (mm)	Length (mm)									
	1600	1800	2000	2200	2500	2600	2800	3000	3200	
25	6300	7100	6300	5600	5600	7100	6300	6300	5600	
	8000	8000	7100	6300	7100	8000	7100	12500	6300	
	12500	10000	9000	8000	8000			12500		12500
			9300	9000	9300					
28	7100	6300	5600	5600	6300	6300	5600	5600	5600	
	10000	7000	6300	7100	7100	7100	6300	6300	9300	
		9000	8000	8000	12500	12500	12500	10000	10000	
		9300	9000					12500		
		10000	9300							
32	6300	5600	7100	6300	5600	5600	5600	9000	8000	
	9000	8000	8000	7100	6300	6300	9300	9300	9000	
	9300	9000		12500	12500	12500	10000	10000	9300	
	10000								10000	
36	5600	7100	6300	5600	5600	5600	8000	8000	7100	
	8000	8000	7100	6300	9300	9300	9000	9000	8000	
	9000		12500	12500	10000	10000	9300	9300	9000	
40	7100	6300	5600	5600	9000	9000	8000	7100	6300	
	8000	7100	6300	10000	9300	9300	9000	8000	7100	
		12500	12500		10000	10000	9300	8000	8000	
45	6300	5600	5000	5000	8000	8000	7100	6300	6300	
	7100	6300	5600	9300	9000	9000	8000	7100	7100	
	12500	12500	10000	10000	9300					
50	5600	5000	5000	8000	7100	7100	6300	5600	5600	
	6300	5600	9000	9000	8000	8000	7100	6300	6300	
	12500	9300	9300	9300						
		10000	10000							
56	5000	5000	8000	7100	6300	6300	5600	5000	5000	
	5600	9300	9000	8000	7100	7100	6300	5600	5600	
	9300	10000	9300							
	10000									
63	4500	8000	7100	6300	5600	5600	5000	4500	4500	
	5000	9300	8000	7100	6300	6300	5600	5000	5000	
	9000									
	9300									
	10000									

Thickness (mm) \ Width (mm)	Length (mm)								
	1600	1800	2000	2200	2500	2600	2800	3000	3200
75	7100	6300	5600	5000	4500	4500	4500	4500	
	8000	7100	6300	5600	5000	5000			
80	6300	5600	5000	4500	4500				
	7100	6300	5600	5000	5000				
	8000	7100	6300	5600					
90	5600	5000	5000	5000					
	6300	5600	5600						
		6300							
100	5000	5000	5000						
	5600	5600							
	6300								
110	5000	5000							
	5600								
120	4500								
	5000								

Note :

- 1) Plates above 40 mm will be flame cut.
- 2) Plates up to 13.5 metre length can also be rolled from slabs of new slab caster.

ROURKELA STEEL PLANT

Rationalised sizes of Plates from Plate Mill (From old Mill)

Thickness (mm) \ Width (mm)	Length (mm)		
	1600	2000	2500
8	–	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000
10	–	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000, 11000, 12000	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000, 11000, 12000
12, 14, 16, 18, 20, 22, 25	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000, 11000, 12000	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000, 11000, 12000	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000, 11000, 12000
28, 32	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000, 11000, 12000	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000, 11000, 12000	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000
36, 40	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000, 11000, 12000	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000	4500, 5000, 5600, 6300, 7100, 8000
45	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000,	4500, 5000, 5600, 6300, 7100, 8000	4500, 5000, 5600, 6300
50	4500, 5000, 5600, 6300, 7100, 8000, 9000, 10000	4500, 5000, 5600, 6300	4500, 5000, 5600, 6300
56	4500, 5000, 5600, 6300, 7100, 8000	4500, 5000, 5600, 6300	4500, 5000, 5600
63	4500, 5000, 5600, 6300, 7100, 8000	4500, 5000, 5600	4500

Note :

1. For 8 mm order acceptable is with mutual agreement.
2. For normalised plates minimum length to be 6300 mm.
3. Plates can be supplied with ultrasonic testing (offline) up to maximum 50 mm thickness.
4. Plates in other sizes can be supplied as per mutual agreement.

Supply Condition

Plates are supplied in bare packaging condition. Plates are normalised as per the requirements of specification. Thickness wise supply conditions are mentioned here :

Thickness (mm)	Supply Condition
8-20 mm	Sheared condition
>20-63 mm	With gas cut edges

Rourkela Steel Plant

Rationalised sizes of Plates from Hot Strip Mill

Thickness (mm)	Width (mm)	Length (mm)
5, 6, 8, 10	1250	5000, 6300, 8000, 10000

Sizes of Chequered Plates of RSP

4, 5, 6, 7, 8, 10	1250	5000, 6300, 8000, 10000
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Note :

1. Plates are supplied in Mill Edge conditions (Width +20 to +50 mm)
2. Chequered plates are supplied with tear drop pattern

BOKARO STEEL PLANT

Rationalised sizes of HR Plates

Thickness (mm)	Width (mm)	Length (mm)
5	1000, 1100, 1250, 1400, 1500, 1600, 1700, 1800	4500, 5000 5600, 6300, 8000
6	1000, 1100, 1250, 1400, 1500, 1600, 1700, 1800	4500, 5000 5600, 6300, 8000
7	1000, 1100, 1250, 1400, 1500, 1600, 1700, 1800	4500, 5000 5600, 6300, 8000
8	1000, 1100, 1250, 1400, 1500, 1600, 1700, 1800	4500, 5000 5600, 6300, 8000
10	1000, 1100, 1250, 1400, 1500, 1600, 1700, 1800	4500, 5000 5600, 6300, 8000
12	1250, 1400, 1500	5000, 6300

Plate Dimensions from New Plate Mill of Rourkela Steel Plant*

Thickness (mm)	Width (mm)		Length (mm)									
	1500	1600	1800	2000	2200	2500	2800	3200	3600	4000	4100	
6, 8							6300	6300				
							7100	7100				
							8000	8000				
							9000	9000				
							10000	10000				
							11000	11000				
							12000	12000				
							12500	12500				
							13000	13000				
							14000	14000				
							15000	15000				
	10, 12							6300	6300	6300	6300	6300
								7100	7100	7100	7100	7100
							8000	8000	8000	8000	8000	
							9000	9000	9000	9000	9000	
							10000	10000	10000	10000	10000	
							11000	11000	11000	11000	11000	
							12000	12000	12000	12000	12000	
							12500	12500	12500	12500	12500	
							13000	13000	13000	13000	13000	
							14000	14000	14000	14000	14000	
							15000	15000	15000	15000	15000	
14, 16, 18		6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300
		7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100
	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	
	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	
	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	
	11000	11000	11000	11000	11000	11000	11000	11000	11000	11000	11000	
	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	
	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	
	13000	13000	13000	13000	13000	13000	13000	13000	13000	13000	13000	
	14000	14000	14000	14000	14000	14000	14000	14000	14000	14000	14000	
	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	
	20, 22, 25, 28 30, 32, 36, 40, 45	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300
		7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100
8000		8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	
9000		9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	
10000		10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	
11000		11000	11000	11000	11000	11000	11000	11000	11000	11000	11000	
12000		12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	
12500		12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	
13000		13000	13000	13000	13000	13000	13000	13000	13000	13000	13000	
14000		14000	14000	14000	14000	14000	14000	14000	14000	14000	14000	
15000		15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	
50		6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300
		7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100
	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	
	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	
	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	
	11000	11000	11000	11000	11000	11000	11000	11000	11000	11000	11000	
	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000	
	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500	
	13000	13000	13000	13000	13000	13000	13000	13000	13000	13000	13000	
	14000	14000	14000	14000	14000	14000	14000	14000	14000	14000	14000	
	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000	

Plate Dimensions from New Plate Mill of Rourkela Steel Plant*

Thickness (mm)	Width (mm)		Length (mm)										
	1500	1600	1800	2000	2200	2500	2800	3200	3600	4000	4100		
63	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	
	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	
	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	
	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	
	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	
	11000	11000	11000	11000	11000	11000	11000	11000	11000	11000	11000	11000	
	12000	12000	12000	12000	12000	12000	12000	12000	12000	12000			
	12500	12500	12500	12500	12500	12500	12500	12500	12500	12500			
	13000	13000	13000	13000	13000	13000	13000	13000	13000				
	14000	14000	14000	14000	14000	14000	14000	14000	14000				
	15000	15000	15000	15000	15000	15000	15000	15000					
	80	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300
		7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100
		8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000
9000		9000	9000	9000	9000	9000	9000	9000	9000	9000	9000	8000	
10000		10000	10000	10000	10000	10000	10000	10000	10000	10000			
11000		11000	11000	11000	11000	11000	11000	11000	11000				
12000		12000	12000	12000	12000	12000	12000						
12500		12500	12500	12500	12500	12500	12500	12500					
13000		13000	13000	13000	13000	13000	13000						
14000		14000	14000	14000	14000	14000	14000						
15000		15000	15000	15000	15000								
90		6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300
		7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100
		8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	8000	
	9000	9000	9000	9000	9000	9000	9000	9000	9000				
	10000	10000	10000	10000	10000	10000	10000	10000	10000				
	11000	11000	11000	11000	11000	11000	11000						
	12000	12000	12000	12000	12000	12000							
	12500	12500	12500	12500	12500	12500	12500						
	13000	13000	13000	13000	13000	13000							
	14000	14000	14000	14000	14000								
	15000	15000	15000	15000									
	110	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300	6300
		7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100	7100
		8000	8000	8000	8000	8000	8000	8000	8000	8000	8000		
9000		9000	9000	9000	9000	9000	9000	9000	9000				
10000		10000	10000	10000	10000	10000	10000	10000					
11000		11000	11000	11000	11000	11000	11000						
12000		12000	12000	12000	12000	12000							
12500		12500	12500	12500	12500	12500							
13000		13000	13000	13000	13000	13000							
14000		14000	14000	14000									
15000		15000	15000										

* After the Mill is fully stabilised. Other sizes as per mutual agreement.

Applications

Specification	Application
IS: 2062/2011 ASTM-A-36	General structurals
IS: 5986/2011	Flanging and forming operations
SAILCOR (IRS M-41) HCRS (Cu + P), ASTM-A-588M, IS: 2062 with Copper	Atmospheric corrosion resistance
SAIL Boiler IS: 2002/2009, ASTM-A-285 (Grade C), ASTM-A-515, ASTM-A-516, ASTM-A-537 (Class 1), ASTM-A-204 (Grade B), DIN 17155 (Grade H1), EN 10028, BS 1501	Boilers and pressure vessels
ASTM-A-517 (Grade F)	Penstock
SAILHARD	Abrasion Resistant
SAILMA 300, 350, 410, 450, 550, 550 HI, 600, as per IS: 2062/2011, IS: 5986/2011, IS: 2062/2011: E300, E350, E410, E450	High Tensile
SAIL Marine IS: 3039, Lloyds Grade A, B, ABS Grade A, NCD 1431, LR Grade E&D, ABS Grade AH/DH/EH-32, 36, NV Grade AB&D	Ship Building
API 5L, Grade A, B, X42, X46, X52, X56, X60, X65	Oil and gas pipeline manufacturing
Chequered Plates conforming to IS: 3502/2009*	Industrial Flooring
Dead Soft Quality	Galvanising Pots and special engineering application
HSFQ 250/350 (Thickness < 8 mm)	Auto Components & Pre Engineered Building (PEB) Sections (For forming at ambient temperature)
SAIL FORMING 250/350 Thickness: 8 - 14 mm	Auto Components (For forming at high temperature - Hot Forming)
SAIL Form 34/38/46 SAIL Super Form 45 (SAPH 440)	Fabrication of long & cross members in auto sector
SAIL HITEN 690 AR	ATM Safe, Earth Moving Equipment
SAIL SPP 400/700 (Hardox 400/Weldox 700) SAIL-FRS	Earth Moving Equipment Fire Resistant Plates

* Base material as per IS: 2062/2011

Plates manufactured by different steel plants as per following specifications

Bhilai Steel Plant

Mild

IS: 2062 E 250 Quality A
 IS: 2062 E 250 Quality BRV/30
 IS: 2062 E 250 Quality C
 IS: 5986 (2011), various grades
 ASTM A/SA 36
 ASTM A/SA 238 Gr. A, B, C, D
 ASTM A/SA 573 Gr. 58, 65
 EN 10025 S 235 JR+AR, 275 JR+AR
 EN 10025 S 235 JR+N, 275 JR+N
 EN 10025 S 235 JO+N, 275 JO+N
 EN 10025 S 235 J2+N, 275 J2+N
 BS 4360 Gr. 43A, B
 BS 4360 Gr. 43C
 BS 4360 Gr. 43D
 JIS G 3101 SS 400, 490
 IRS/LRS/ABS/GL/DNV Gr. A
 LRS/ABS/GL/DNV Gr. B
 LRS/ABS/GL/DNV Gr. D
 Dead Soft Quality
 NES 791 PART 1

API

API 5L Gr. A, B
 API 5L X 42, 46, 52, 56
 APL 5L X 60, 65, 70

High Tensile

IS: 2062 E 300
 IS: 2062 E 350
 IS: 2062 E 410
 IS: 2062 E 450
 IS: 2062 E 450
 IS: 5986 (2011) higher grades
 SAIL MA 300
 SAIL A 300 HI, 350 HI
 SAIL A 410
 SAIL MA 410 HI
 SAIL MA 450
 SAIL MA 450 HI
 ASTM A/SA 572, Gr. 42, 50, 55
 ASTM A/SA 573, Gr. 70
 BS 4360, Gr. 50B

EN 10025 S355 JR+N
 EN 10025 S355 JO+N
 EN 10025 S355 J2+N
 GOST 09G25, 10G2S1-Cat 1
 GOST 09G25, 10G2S1-Cat 2
 GOST 09G25, 10G2S1-Cat 3
 GOST 521, Gr. 10 KhSND
 JIS G 3106 SM 490A
 JIS G 3106 SM 490B
 ABS AH32, AH36, DH32, DH36
 ABS AH36, EH36
 NCD 1431

Boiler Quality

IS: 2002 Gr. 1
 IS: 2002 Gr. 1 (For fire box)
 IS: 2002 Gr. 2
 IS: 2002 Gr. 3
 ASTM A/SA 515 Gr. 60, 65, 70
 ASTM A/SA 516 Gr. 55, 60, 65, 70
 ASTM A/SA 285 Gr. A, B, C
 BS 1501/1/224 Gr. 400A, 430A
 DIN 17155H1
 EN 10028-2 P235GH, 265GH
 EN 10028-3 P275N, P355NL1
 ASTM A/SA 537 C1 1
 BS 1501-1-224 Gr. 460A, 490A
 EN 10028-3 P355 N, P355 NL1

Special Steel

SAIL HARD
 SAIL HITEN AR 690
 HOT SAW DISC
 IRS M 41
 ASTM A/SA 588 Gr. A
 ASTM A/SA 204, Gr. A, B, C
 DIN 17155 Gr. 15 Mo3
 DMR 249 Gr. A
 SAIL MA 550
 SAIL MA 550 HI
 SAIL MA 600
 SAIL MA 600 HI
 SAIL -FRS

Rourkela Steel Plant

IS: 2062/2011
 ASTM-A-36
 SAILMA
 300HI/350HI/410HI/
 450HI
 Lloyds Grades A, B, D
 IS: 2002/2009
 ASTM-A-285 M
 Grade C
 Dead Soft Quality
 LO-Pearl
 IS: 5986/2011
 IS: 3502/2009
 ASTM-A-517 Gr. F
 IS: 3039/1988
 SAPH 440
 ASTM-A-537 Cl I
 ASTM-A-515/ 516
 Grades- 60/65/70
 BSK-46
 API 5L grade
 A, B, X 42,
 X46, X52, X56
 X60, X65
 SAIL SPP 400/700

Bokaro Steel Plant

IS: 2062/2011
 SAILMA 300HI/350HI
 E38/ E34
 SAILCOR/ HCRS
 IRSM-41
 BSK-46/E-46
 SAPH-45
 IS: 2002/2009
 IRS Gr. A
 E-550, E-500, E-450
 ASTM A 36
 JIS 3101 SS 4011
 IS: 5986/2017
 IS: 6240/2008

Rolling and cutting tolerance for plates (as per IS 1852/2003)

Width

The tolerances on width of plate shall be as follows

Length (mm)	Width (mm)	Thickness (mm)	Tolerance on Width
Up to and including 8000	Up to and including 2000	Up to and including 20	- 0, +10 mm
		Over 20	-0, +15 mm
Up to and including 8000	Over 2000	Up to and including 20	- 0, +0.5% of width
		Over 20	-0, +20 mm
Over 8000	All widths	Up to and including 20	- 0, +0.2% of length
		Over 20	-0, +0.3% of length

Note 1 : Plates over 20 mm in thickness may be supplied with either as rolled or gas-cut edges. In case of Bhilai plates, above 40 mm thick plates shall be supplied with flame cut edges. The tolerances on width in such cases shall be subject to arrangement between the purchaser and the supplier.

Note 2 : In case plates below 20 mm in thickness are supplied in as-rolled condition the tolerances shall be mutually agreed to between the purchaser and the supplier.

Note 3 : Plates from BSP is supplied in trimmed condition. For untrimmed plates, width tolerance will be (+) 100 mm, (-) 0 mm.

Thickness

The tolerances on thickness shall be as follows :

Thickness	Tolerance in percentage of nominal Thickness
Less than 8 mm	+12.5, - 5.0
From 8 mm up to & including 12 mm	+7.5, - 5.0
Over 12 mm	± 5.0

The thickness shall be measured at the following points

- One at each corner of the plate.
- One in the middle of the width, and
- One in the middle of the length.

These measurements shall be 25 mm away from the edge and at points randomly chosen. The thickness measured at each of these points shall satisfy the tolerances specified above.

Length (mm)

Length (mm)		Thickness (mm)	Tolerance on length
Over	Up to and including		
—	2200	Up to and including 20 Over 20	- 0, + 10 mm - 0, + 15 mm
2200	3000	Up to and including 20 Over 20	- 0, + 0.5% - 0, + 15 mm
3000	6300	Up to and including 20 Over 20	- 0, + 0.5 % - 0, + 0.5 %
6300	8000	Up to and including 20 Over 20	- 0, + 35 mm - 0, + 0.5 %
8000	—	Up to and including 20 Over 20	- 0, + 35 mm - 0, + 40 mm

The tolerance for length of plates from 5 to 10 mm thickness when produced in continuous mill shall be as follows

Length (mm)	Tolerance
Up to and including 2500	+ 25 mm, - 0 mm
Over 2500	+ 1 percent of the length subject to a maximum of 70 mm, - 0 mm

Note : Plates over 20 mm in thickness may be supplied with either as-rolled or gas-cut edges. In case of Bhilai plates, above 40 mm thick plates shall be supplied with flame cut edges. The length tolerance in such cases shall be subject to agreement between the purchaser and the supplier.

Chemical Composition

Grade	C % max	Mn % max	P % max	S % max	Others%	
SAIL-FRS	0.20	1.5	0.040	0.040	Cr+Mo = 1.00	Nb+V+Ti = 0.12 max

Note: Micro alloying elements like Nb, V, Ti or B shall be added singly or in combination and total micro alloying shall be as indicated or as per mutual agreement between SAIL & Purchaser.

Chemical Composition : IS 5986/2011

Grade	Constituents, Percent, Max				
	Carbon	Manganese	Phosphorus	Sulphur	Carbon Equivalents
165	0.12	0.60	0.040	0.040	—
205	0.15	0.80	0.040	0.040	—
235	0.17	1.00	0.040	0.040	—
255	0.20	1.30	0.040	0.040	0.42
325	0.20	1.30	0.040	0.040	0.42
355	0.20	1.50	0.035	0.035	0.45
420	0.20	1.50	0.035	0.035	0.45
490	0.20	1.50	0.035	0.030	0.45
560	0.20	1.50	0.035	0.030	0.45

Notes:

1. The nitrogen content of the steel shall not be more than 0.009 percent. For aluminium killed or aluminium silicon killed the nitrogen content shall not exceed 0.012 percent. This shall be ensured by ensured by occasional checking.
2. When the steel is killed by aluminium the total aluminium content should not be less than 0.02 percent. When steel is silicon content shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent.
3. The material may be supplied in the copper bearing quality in which case the copper shall be between 0.20 and 0.35 percent on analysis.
4. The steel can be made with micro-alloying element like Nb, V, Ti and B either individually or in combination on mutual agreement. In which case the total micro-alloying elements should not exceed 0.2 percent in ladle analysis. However, in case of boron, the limit shall be 0.001 percent.
5. As the form of sulphide inclusions may have certain influence on the cold forming properties, steel may be treated with elements like Ce or Ca, if agreed to between the manufacturer and purchaser.

$$\text{Carbon equivalent (CE) based on ladle analysis} = C + \frac{\text{Mn}}{6} + \frac{(\text{Cr} + \text{Mo} + \text{V})}{5} + \frac{(\text{Ni} + \text{Cu})}{15}$$

Mechanical Properties : IS 5986/2011

Specification	Grade	Yield Strength MPa, Min	Ultimate Tensile Strength, MPa, Min	Elongation%	Internal Diameter of bend	
				min GL5.65 $\sqrt{S_0}$	≤ 12 mm	> 12 mm
IS:5986:2011	165	165	290-400	> 3 mm	Close	t
	205	205	330-440	30	t	2t
	235	235	360-470	28	t	2t
	255	255	410-520	26	t	2t
	325	325	420-530	24	2t	3t
	355	355	420-530	19	2t	3t
	420	420	480-590	18	2t	3t
	490	490	540-650	15	2t	3t
	560	560	610-720	12	2t	3t

Grade 165 may be supplied based on chemical composition only, if agreed to

Chemical Composition IS: 2062/2011

Grade	Quality	Ladle Analysis, wt % Max					Carbon Equivalent, Max	Mode of Deoxidation
		C	Mn	S	P	Si		
E 250	A	0.23	1.50	0.045	0.045	0.40	0.42	Semi Killed/Killed
	BR, BO	0.22	1.50	0.045	0.045	0.40	0.41	Semi Killed/Killed
	C	0.20	1.50	0.040	0.040	0.40	0.39	Killed
E 275	A	0.23	1.50	0.045	0.045	0.40	0.43	Semi Killed/Killed
	BR, BO	0.22	1.50	0.045	0.045	0.40	0.42	Semi Killed/Killed
	C	0.20	1.50	0.040	0.040	0.40	0.41	Killed
E 300	A, BR, BO	0.20	1.50	0.045	0.045	0.45	0.44	Semi Killed/Killed
	C	0.20	1.50	0.040	0.040	0.45	0.44	Killed
E 350	A, BR, BO	0.20	1.55	0.045	0.045	0.45	0.47	Semi Killed/Killed
	C	0.20	1.55	0.040	0.040	0.45	0.45	Killed
E 410	A, BR, BO	0.20	1.60	0.045	0.045	0.45	0.50	Semi Killed/Killed
	C	0.20	1.60	0.040	0.040	0.45	0.50	Killed
E 450	A, BR	0.22	1.65	0.045	0.045	0.45	0.52	Semi Killed/Killed
E 550	A, BR	0.22	1.65	0.020	0.025	0.50	0.54	Semi Killed/Killed
E 600	A, BR	0.22	1.70	0.020	0.025	0.50	0.54	Semi Killed/Killed

Notes:

1. New grade designation system based on minimum yield stress has been adopted.
2. For semi-killed steel, silicon shall be less than 0.10 percent. For killed steel, when the steel is killed by aluminium alone, the total aluminium content shall not be less than 0.02 percent. When the steel is killed by silicon alone, the silicon content shall not be less than 0.10 percent. When the steel is silicon-aluminium killed, the silicon content shall not be less than 0.03 percent and total aluminium content shall not be less than 0.01 percent.
3. Steels of qualities A, BR, BO and C are generally suitable for welding processes. The weldability increases from quality A to C for grade designation E 250 and E 275.
4. Carbon equivalent (CE) would be calculated based on ladle analysis, only

$$CE = C + \frac{Mn}{6} + \frac{(C + Mo + V)}{5} + \frac{(Ni + Cu)}{15}$$

5. Micro-alloying elements like Nb, V and Ti may be added singly or in combination. Total micro-alloying elements shall not be more than 0.25 percent.

Chemical Composition IS: 2062/2011

6. Alloying elements such as C, Ni, Mo and B may be added under agreement between the purchaser and the manufacturer. In case of E 600 and E 650 the limit of C and Ni either singly or in combination, shall not exceed 0.50 percent and 0.60 percent respectively.
7. Copper may be present between 0.20 to 0.35 percent as mutually agreed to between the purchaser and the manufacturer. The copper bearing quality shall be designated with a suffix Cu, for example E 250 Cu. In case of product analysis the copper content shall be between 0.17 and 0.38 percent.
8. Incidental element - Elements not quoted in Table 1 shall not be intentionally added to steel without the agreement of the purchaser, other than for the purpose of finishing the heat. All reasonable precautions shall be taken to prevent the addition from scrap or other materials used in manufacturer of such elements which affect the hardenability, mechanical properties and applicability.
9. Nitrogen content of steel shall not exceed 0.012 percent which shall be ensured by the manufacturer by occasional check analysis.
10. The steel, if required, may be treated with calcium based compound or rare earth element for better formability.
11. Lower limits for carbon equivalent and closer limits for other elements may be mutually agreed to between the purchaser and the manufacturer.

Mechanical Properties : 2062/2011

Grade Designation	Quality	Tensile Strength R _m Min MPa	Yield Stress Min MPa			Percentage Elongation A, at Gauge Length, L=5.65 √S ₀ Min	Internal Bend Diameter Min		Charpy Impact Test	
			≤ 20	20-40	>40		<25	>25	Temp °C	J, Min
E-250	A	410	250	240	230	23	2t	3t	-	-
	BR								RT	27
	BO								0	27
	C								(-) 20	27
E-275	A	430	275	265	256	22	2t	3t	-	-
	BR								RT	27
	BO								0	27
	C								(-) 20	27
E-300	A	440	300	290	280	22	2t	-	-	-
	BR								RT	27
	BO								0	27
	C								(-) 20	27
E-350	A	490	350	330	320	22	2t	-	-	-
	BR								RT	27
	BO								0	27
	C								(-) 20	27
E-410	A	540	410	390	380	20	2t	-	-	-
	BR								RT	25
	BO								0	25
	C								(-) 20	25
E-450	A	570	450	430	420	20	2.5t	-	-	-
	BR								RT	20
E-550	A	650	550	530	520	12	3.0t	-	-	-
	BR								RT	15
E-600	A	730	600	580	570	12	3.5t	-	-	-
	BR								RT	15

- In case of product thickness/diameter more than 100 mm, lower minimum limit of tensile strength may be mutually agreed to between the purchaser and the manufacturer/supplier

Chemical Composition : SAILMA Grades

Grade	C max.	Mn max.	S max.	P max.	Al min.	Si max.	CE max.	MAE (Nb+V+Ti) max.
SAILMA 300	0.20	1.50	0.045	0.045	0.02	0.45	0.44	≤ 0.25
SAILMA 300 HI	0.20	1.50	0.040	0.040	0.02	0.45	0.43	≤ 0.25
SAILMA 350	0.20	1.55	0.045	0.045	0.02	0.45	0.46	≤ 0.25
SAILMA 350 HI	0.20	1.55	0.040	0.040	0.02	0.45	0.45	≤ 0.25
SAILMA 410	0.20	1.60	0.045	0.045	0.02	0.45	0.48	≤ 0.25
SAILMA 410 HI	0.20	1.60	0.040	0.040	0.02	0.45	0.48	≤ 0.25
SAILMA 450	0.20	1.65	0.045	0.045	0.02	0.45	0.50	≤ 0.25
SAILMA 450 HI	0.20	1.65	0.040	0.040	0.02	0.45	0.50	≤ 0.25
SAILMA 550	0.20	1.65	0.020	0.025	0.02	0.50	0.54	≤ 0.25
SAILMA 550 HI	0.20	1.65	0.015	0.025	0.02	0.50	0.54	≤ 0.25
SAILMA 600	0.22	1.70	0.015	0.025	0.02	0.50	0.54	≤ 0.25

For Hot Rolled coils, S is maintained below 0.030%

Mechanical Properties : SAILMA Grades

Grade	YS, MPa min			UTS Mpa, min	% EI min Std GL	Internal Bend Diameter, min		Charpy Impact Test	
	≤25 mm	25-40 mm	>40 mm			≤25mm	>25 mm	Temp ⁰ C	J, min
SAILMA 300	300	290	280	440	24	2t	-	-	-
SAILMA 300 HI	300	290	280	440	24	2t	-	0	40
SAILMA 350	350	330	320	490	24	2t	-	-	-
SAILMA 350 HI	350	330	320	490	24	2t	-	0 -20	40 30
SAILMA 410	410	390	380	540	22	2t	-	-	-
SAILMA 410 HI	410	390	380	540	22	2t	-	0 -20	35 25
SAILMA 450	450	430	420	570	22	2.5t	-	-	-
SAILMA 450 HI	450	430	420	570	22	2.5t	-	0 -20	30 20
SAILMA 550	550	530	520	650	14	3t	-	-	-
SAILMA 450 HI	550	530	520	650	14	3t	-	0 -20	25 15
SAILMA 600	600	580	570	730	14	3.5t	-	-	-

Impact will be given for any one temperature. For 450 HI & above impact is for < 10 mm. For < 12 mm impact to be given only if specified.

Chemical Composition : SAILCOR

Specification	Grade	C % max	Mn % max	P % max	S % max	Si % max	Al % min
IS:11513 CR 4	SAIL SOFT	0.06	0.25	0.025	0.025	0.04	0.020
SAILCOR	IRSM 41	0.10	0.25-0.45	0.75-0.140	0.030	0.28-0.72	
Cr 0.35-0.60, Ni 0.20-0.47, Cu 0.30-0.60, Al 0.03 max							

Mechanical Properties : SAILCOR

Specification	Grade	Yield Strength MPa min	Ultimate Tensile Strength MPa min	Elongation% Std GL	Internal Diameter of bend
SAILCOR	HR	340	480	22	t

IS: 2041-2009 - Chemical Composition (wt %)

(Steel Plates for pressure vessels used at moderate and low temperature)

Grade	C max	Si	Mn	P max	S max	Al (total) min	N max	Nb max	V max	Ti max	Nb+V+Ti min	Cr max	Cu max	Mo max	Ni max
R 220	0.21	0.15-0.35	0.60-1.50	0.035	0.035	0.020	0.012	—	—	—	—	—	—	—	—
R 260	0.25	0.15-0.35	0.85-1.50	0.035	0.035	0.020	0.012	—	—	—	—	—	—	—	—
R 275	0.16	0.40 max	0.80-1.50	0.025	0.015	0.020	0.012	0.05	0.05	0.03	0.05	0.30	0.30	0.08	0.50
R 355	0.18	0.50 max	1.10-1.70	0.025	0.015	0.020	0.012	0.05	0.10	0.03	0.12	0.30	0.30	0.08	0.50
H 235	0.16	0.35 max	0.60-1.20	0.025	0.015	0.020	0.012	0.02	0.02	0.03	0.06	0.30	0.30	0.08	0.30
H 265	0.2	0.40 max	0.80-1.40	0.025	0.015	0.020	0.012	0.02	0.02	0.03	0.06	0.30	0.30	0.08	0.30
H 295	0.2	0.40 max	0.90-1.50	0.025	0.015	0.020	0.012	0.02	0.02	0.03	0.06	0.30	0.30	0.08	0.30

NOTES :

- For Grades R220, R 260, R275, R355 Carbon content over the maximum specified shall be increased by 0.03 percent for plates over 12 mm thickness.
- Microalloying elements Nb and V maybe added to Grades R220 & R260, subject to mutual agreement between purchaser and manufacturer/supplier.
- For product thicknesses <6 mm, a minimum Mn of 0.6 percent is permitted.
- The minimum Al (total) content may not be applicable, if Nb, Ti or V either singly or in combination are additionally used for Nitrogen binding.
- If only Al is used for nitrogen binding, a ratio Al/N >= 2 shall apply.
- Cr+Cu+Mo shall not exceed 0.45 percent.
- Elements not listed in the table shall not be intentionally added to the steel without agreement of the purchaser.
- Closer limits of composition maybe agreed to between the supplier and the purchaser.
- Whenever micro alloying elements are added for achieving the strength, maximum carbon equivalent shall not exceed 0.50 for steels used for welding.
- Carbon equivalent (CE) based on ladle analysis = $C + Mn/6 + \sqrt{Cr+Mo+V}/5 + (Ni+Cu)/15$.

IS: 2041- 2009 Mechanical Properties

(Steel Plates for pressure vessels used at moderate and low temperature)

Grade	Yield Stress MPa, min					Tensile Strength MPa	Elongation % on Gauge Length 5.65 $\sqrt{S_0}$, min	Impact Energy (J) min at a temperature in °C			0.2% proof stress at 300° C MPa, min		
	<= 16 mm	> 16 to 40 mm	> 40 to 60 mm	> 60 to 100 mm				20	0	-20		-40	
R 220	220	220	220	220	415-540	21	20	50	40	27	20	—	Impact test optional for R 220 and R 260
R 260	260	260	260	260	490-620	21	50	40	40	27	20	—	
R 275	275	265	255	235	390-510	23	80	70	50	50	40	—	
R 355	355	345	335	315	490-640	21	80	70	50	50	40	—	
H 235	235	225	215	200	360-480	24	40	34	27	—	—	153	
H 265	265	255	245	215	410-530	22	40	34	27	—	—	173	
H 295	295	290	285	260	460-580	21	40	34	27	—	—	192	
H 355	355	345	335	315	510-650	20	40	34	27	—	—	232	

NOTES :

1. Impact test shall be at any one temperature as mutually agreed.
2. Impact test is optional for Grades R220 and R260.
3. The orientation of Impact test specimen shall be longitudinal to the rolling direction for R220, R260, R275, R355 grades and transverse to the rolling direction for H235, H265, H295 and H355 grades.
4. Stringent impact test temperature and values can be mutually agreed.
5. For thickness ≥ 100 mm, Yield stress to be mutually agreed.

Chemical Composition

Specification	Grade	C %	Mn %	P % max	S % max	Si %	CE
ASTM-A-36	–	0.25 max	0.80- 1.20	0.04	0.05	0.15- 0.40	
ASTM-A-588	–	0.19 max	0.80- 1.25	0.040	0.050	0.30- 0.65	
Al 0.02 min, Cr 0.40-0.65, Ni 0.40 max, Cu 0.25-0.40, V 0.02-0.10							
HCRS (Cu+P)		0.25-0.8 0.15	0.25-0.8 0.15	0.03		0.28-0.5 0.50	Cu 0.2 min
Al 0.03 max, Cr 0.35-0.60, Ni 0.20-0.47, Cu 0.30-0.60 V 0.05 max							
IS: 2002/2009	1	0.18 max	0.50- 1.20	0.035	0.040	0.15- 0.35	0.44 max Cu 0.10% max (residual)
	2	0.20 max	0.50- 1.20	0.035	0.040	0.15- 0.35	0.44 (max) Al 0.020% max
	3	0.22 max	0.50- 1.20	0.035	0.040	0.15- 0.35	0.44 max
ASTM-A-285	C	0.28 max	0.90	0.035	0.035		
ASTM-A-515	60	0.24 – 0.27	0.90	0.035	0.035	0.15- 0.40	Al 0.02% max
	65	0.28 – 0.31	0.90	0.035	0.035	0.15- 0.40	
	70	0.31 – 0.33	1.20	0.035	0.035	0.15- 0.40	
ASTM-A-516	55	0.18 – 0.22	0.60- 0.90	0.035	0.035		
	65	0.24 – 0.28	0.85- 1.20	0.035	0.035		
	70	0.27 – 0.30	0.85- 1.20	0.035	0.035		

– For each reduction of 0.10% of C below the specified max, an increase of 0.60% of Mn above the specified max is permitted up to 1.50%.

– Grade 60 plates, Mn 0.85-1.20 for thickness \leq 12.5 mm

– Heats will be micro alloyed for orders requiring impact test

ASTM-A-537	Cl 1	0.24 max	0.7- 1.60	0.035	0.035	0.15- 0.50	Micro alloyed with Nb/V, if required
Al 0.02 min, Cr 0.25 max, Ni 0.25 max, Cu 0.35 max, Mo 0.08 max							
DIN 17155	H1	0.16	0.40-1.20	0.035	0.030	0.35	
Al 0.02% min, Cr 0.25% max, Ni 0.30% max, Cu 0.30% max, Nb 0.01% max, V 0.03% max, Ti 0.03% max, Mo 0.10% max							

Mechanical Properties

Specification	Grade	Yield Strength, MPa, Min	Ultimate Tensile Strength, MPa, Min	Elongation % min GL5.65 $\sqrt{S_0}$		Internal diameter of bend		
ASTM-A-36		250	400-550	200 mm GL -18 50 mm GL-21				
ASTM-A-588		345	485 min	200 mm GL 16	50 mm GL 19	≤ 20 1t	>20 <25 1.5t	>25 <40 2t

Specification	Grade	YS MPa min			UTS MPa min <25	EI% min GL = 5.65 $\sqrt{S_0}$	Internal diameter of bend
		<16 mm	16-40 mm	40-60 mm			
IS 2002/2009	1	235	225	215	360-480	24	2T
	2	265	255	245	410-530	22	2T
	3	290	285	280	460-580	21	3T

Specification	Grade	YS MPa min	UTS MPa min	EI% min		Internal diameter of bend
				200 mm GL	50 mm GL	
ASTM-A285	C	205	385-515	23	27	—
ASTM-A515	60	220	415-550	21	25	—
	65	240	450-585	19	23	—
	70	260	485-620	17	21	—
ASTM-A516	55	205	380-515	23	27	—
	60	220	415-550	21	25	—
	65	240	450-585	19	23	—
	70	260	485-620	17	21	—
Charpy Impact energy 18 J for Gr 60 & 65 at -51°C and 20J for Gr 70 at -46°C for -25 mm: 18J for Gr 60 & 65 at -46°C and 20J for Gr 70 at -40°C for $>25 <50$						
ASTM-A-537	Class I	345		485-620	18	22
DIN 17155	HI	235 for <16 mm	225 for 16-40 mm	360-480	24	

Charpy Impact energy 31J at 0°C

For ASTM-A-588/285/204/ 515/ 516/ 537

Bend Test is a supplementary requirement

Chemical Composition

Specification	Grade	C % max	Mn % max	P % max	S % max	Si % max	CE
ASTM-A-204	B	0.20-0.23	0.90	0.035	0.035	0.15-0.40	
		Mo 0.45 - 0.60%					
ASTM-A-517	F	0.1-0.2	0.6-1.0	0.035	0.035	0.15-0.35	
		Ni 0.7-1.0, Cr 0.4-0.65, Mo 0.4-0.6, V 0.03-0.08, Cu 0.15- 0.50, Bo 0.0005-0.0006					

Chemical Composition : API 5 L

Specification	Steel Grade	% ^{a, g}						
		C Max	Mn Max	P Max	S Max	V Max	Nb Max	Ti Max
PSL 1	A	0.22	0.90	0.030	0.030	-	-	-
	B	0.26	1.20	0.030	0.030	c, d	c, d	d
	X42	0.26	1.30	0.030	0.030	d	d	d
	X46	0.26	1.40	0.030	0.030	d	d	d
	X52	0.26	1.40	0.030	0.030	d	d	d
	X56	0.26	1.40	0.030	0.030	d	d	d
	X60	0.26 ^e	1.40 ^e	1.40	0.030	f	f	f
	X65	0.26 ^c	1.45 ^c	0.030	0.030	f	f	f
	X70	0.26 ^c	1.65 ^c	0.030	0.030	f	f	f

- ^a Cu ≤ 0.50%; Ni ≤ 0.50%; Cr ≤ 0.50% and Mo ≤ 0.15%
- ^b For each reduction of 0.01% below the specified maximum concentration for carbon, an increase of 0.05% above the specified maximum concentration for Mn is permissible, up to a maximum of 1.65% for grades ≤ B, but ≤ X52; up to a maximum of 1.75% for grades > X52, but < X70; and up to a maximum of 2.00% for grade X70.
- ^c Unless otherwise agreed, Nb + V ≤ 0.06%
- ^d Nb + V + Ti ≤ 0.15%
- ^e Unless otherwise agreed
- ^f Unless otherwise agreed, Nb + Ti ≤ 0.15%
- ^g No deliberate addition of B is permitted and the residual B ≤ 0.001%

Chemical Composition : API 5 L

Speci- fication	Steel grade	% Maximum									Carbon equivalent a % maximum	
		C ^b	Si	Mn ^b	P	S	V	Nb	Ti	Other	CE _{IW}	CE _{Pcm}
PSL2		Welded Pipe										
	BM	0.22	0.45	1.20	0.025	0.015	0.05	0.05	0.04	d,h	0.43	0.25
	X42M	0.22	0.45	1.30	0.025	0.015	0.05	0.05	0.04	d,h	0.43	0.25
	X46M	0.22	0.45	1.30	0.025	0.015	0.05	0.05	0.04	d,h	0.43	0.25
	X52M	0.22	0.45	1.40	0.025	0.015	c	c	c	d,h	0.43	0.25
	X56M	0.22	0.45	1.40	0.025	0.015	c	c	c	d,h	0.43	0.25
	X60M	0.12 ^e	0.45 ^e	1.60 ^e	0.025	0.015	f	f	f	g,h	0.43	0.25
	X65M	0.12 ^e	0.45 ^e	1.60 ^e	0.025	0.015	f	f	f	g,h	0.43	0.25
	X70M	0.12 ^e	0.45 ^e	1.70 ^e	0.025	0.015	f	f	f	g,h	0.43	0.25

- ^a Based upon product analysis. The CE_{IW} limits apply if C > 0.12% and the CE_{Pcm} limits apply if C ≤ 0.12%
- ^b For each reduction of 0.01% below the specified maximum for C, an increase of 0.05% above the specified maximum for Mn is permissible, up to a maximum of 1.65% for grades ≤ B, but ≤ X52; up to a maximum of 1.75% for grades ≥ X 52, but ≤ X70; up to a maximum of 2.00% for grade X70
- ^c Nb + V + Ti ≤ 0.15%
- ^d Unless otherwise agreed, Cu ≤ 0.50%; Ni ≤ 0.30%; Cr ≤ 0.30% and Mo ≤ 0.15%
- ^e Unless otherwise agreed
- ^f Unless otherwise agreed, Nb + V + Ti ≤ 0.15%
- ^g Unless otherwise agreed, Cu ≤ 0.50%; Ni ≤ 0.50%; Cr ≤ 0.50% and Mo ≤ 0.50%
- ^h Unless otherwise agreed no intentional addition of B is permitted and residual B ≤ 0.001%

Chemical Composition

Specification	Grade	C % max	Mn % max	P % max	S % max	Si % max	CE	
	I	0.23	*	0.040	0.040	**	0.42	***
IS: 3039/1988	* Mn content not less than 2.5 times Carbon content if thickness > 12.5 mm. ** Si 0.10-0.35% if killed quality. *** Al min 0.01%							
	II	0.21	0.70-1.4	0.040	0.040	0.10-0.35		
	III	0.18	0.70-1.5	0.040	0.040	0.19-0.50	#	
	# Al min 0.015% for grade III							
Lloyds Grade	A	0.21	2.5xC% min	0.035	0.035	0.50		
	B	0.21	0.80min	0.035	0.035	0.35		
For Gr B Mn 0.60% min if impact tested.								
SAILHARD		0.23	1.6	0.050	0.050	0.50		
	Al 0.10 max, Cr 0.65 max, Nb+V+Ti 0.15 max							
GOST 19282	09G2S	0.12	1.3-1.7	0.035	0.040	0.5-0.8		
	10G2S1	0.12	1.3-1.65	0.035	0.040	0.8-1.1		
	Al 0.050 max, Cr 0.30 max, Ni 0.30 max, Cu 0.30 max, Ti 0.03 max, N 0.008 max							
Specification	Grade	C % max	Mn % max	P % max	S % max	Si %	Others	
SAIL SPP 400	Hardox 400	0.22	1.60	0.02	0.01	0.10-0.70	Cr : 1.40 max Mo : 0.60 max Ni : 0.50 max B : 40 ppm max	
SAIL SPP 700	Weldox 700E	0.20	1.60	0.02	0.01	0.60 max	Cr : 0.70 Mo : 0.70 V : 0.08	
SAIL HITEN 690 AR		0.22	1.60	0.025	0.015	0.60	Al - 0.02 max V - 0.20 max Ti - 0.02 max Nb - 0.050 max	

Mechanical Properties

Specification	Grade	Yield Strength MPa Min		Ultimate Tensile Strength MPa Min	Elongation % min GL $5.65 \sqrt{S_0}$	Internal diameter of bend	
ASTM-A-204 M					200 50 mm mm	<25 >25 mm < 40 mm	
	B	275		485-620	17 21	1.5T 2T	
ASTM-A-517	F	690		795-930	16		
API 5L (PSL-I)	A	210		335			
	B	245		415			
	X-42	290		415	% elongation $1.940A^{0.2}/U^{0.9}$ (GL: 50.8 mm) for all API Grades A: Cross sectional area in mm ² U: Minimum UTS in MPa		
	X-46	320		435			
	X-52	360		460			
	X-56	390		490			
	X-60	415		520			
	X-65	450		535			
	X-70	485		570			
IS 3039/1988		≤ 25 mm	> 25 < 50 mm				
	I	230	220	400-900		22	
	II	235	235	400-900	22		
	III	235	235	400-900	22		
Lloyds Grade	A	235		400-520	22		
	B	235		400-520	22	CE : 27 J at 0°C	

Impact 27J at 0°C for >25mm

Mechanical Properties

Steel grade (PSL 2)	Yield strength ^a R _{10.5} MPa		Tensile strength ^a R _m MPa		Ratio ^{3,c} R _{10.5} / R _m	Elongation (on 50 mm) A%
	minimum	maximum	minimum	maximum	maximum	minimum
BM	245	450 ^c	415	655	0.93	d
X42M	290	495	415	655	0.93	d
X46M	320	525	435	655	0.93	d
X52M	360	530	460	760	0.93	d
X56M	390	545	490	760	0.93	d
X60M	415	565	520	760	0.93	d
X65M	450	600	535	760	0.93	d
X70M	485	635	570	760	0.93	d

^a For intermediate grades, the difference between the specified maximum yield strength and the specified minimum yield strength shall be as given in the table for the next higher grade, and the difference between the specified minimum tensile strength and the specified minimum yield strength shall be as given in the table for the next higher grade. For intermediate grades up to X46, the tensile strength shall be ≤ 655 MPa. For intermediate grades greater than X46 and lower than X70, the tensile strength shall be ≤ 760 MPa. The calculated value shall be rounded to the nearest 5 MPa

^b This limit applies for pipe with $D > 323.9$ mm (12.750 in).

^c For pipe requiring longitudinal testing, the maximum yield strength shall be ≤ 495 MPa.

^d The specified minimum elongation, A_f shall be as determined using the following equation:

$$A_f = C/A^{0.2} \times C/U^{0.9} \text{ where}$$

C is 1.940 for calculations;

A_{vc} is the applicable tensile test piece cross-sectional area, expressed in square millimetres as follows:

– for circular cross-section test pieces. 130 mm² for 12.7 mm and 8.9 mm diameter test pieces; and 65 mm² for 6.4 mm diameter test pieces;

– for full-section test pieces, the lesser of (a) 485 mm² and (b) the cross-sectional area of the test piece, derived using the specified outside diameter and the specified wall thickness of the pipe, derived using the specified outside diameter and the specified wall thickness of the pipe, rounded to the nearest 10 mm²;

– for strip test pieces, the lesser of (a) 485 mm² and (b) the cross-sectional area of the test piece, derived using the specified width of the test piece and the specified wall thickness of the pipe, rounded to the nearest 10 mm²;

U is the specified minimum tensile strength, expressed in megapascals

Mechanical Properties

Specification	Grade	Yield Strength (MPa min)	Ultimate Tensile Strength (MPa min)	%Elongation (min)	Bend	Hardness
SAILHARD						200 BHN
DSQ LO-PEARL		245	375	25	37	
SAIL SPP 400	HARDOX 400	900	1100	10		
SAIL SPP 700	WELDOX 700E	620	725-860	16		
SAIL HITEN		550	690	15	3.5T	
GOST 19282	09G2S	345 (t:8-10) 325 (t:10-20) 305 (t:20-32) 285 (t:32-40)	490 (t:8-10) 470 (t:10-20) 460 (t:20-32) 450 (t:32-40)	21	2T	
	10G2S1	345 (t:8-10) 335 (t:10-20) 325 (t:20-32) 325 (t:32-40)	490 (t:8-10) 480 (t:10-20) 470 (t:20-32) 450 (t:32-40)	21	2T	

Note : The mechanical properties specified in API Grades are for pipes only.
HRC/Plate properties are to be mutually agreed upon by the producers & pipe manufacturers.

ABS Steel Plates

Grade	Chemistry	Tensile Strength
A	C 0.21, Mn 2.5 x C% min S, P 0.035, Si : 0.50 max Al 0.02 min, CE 0.40	YS 235 MPa, % EL : 22 (50 GL) UTS 400-520 MPa Impact 34J/RT (> 50 mm)
B	C 0.21, Mn 0.80 min S, P 0.035, Si : 0.35 max Al 0.02 min, CE 0.40	YS 235 MPa UTS 400-520 MPa Impact 27J/0° (> 25 mm)
C	C 0.21, Mn 0.60 min S, P 0.035 Al 0.03 min, CE 0.040	YS 315 MPa UTS 400-520 MPa Impact 27J/-20°C for all thicknesses
AH 32 DH 32 EH 32	C 0.18, Mn 0.90-1.60 Nb 0.02-0.05, Si : 0.50 max S 0.035, P 0.035 V 0.05-0.10, Ti 0.02 max	YS 315 MPa, UTS : 440-590 MPa Imp AH 32 34 J min at 0°C DH 32 34 J min at -20°C EH 32 34 J min at -40°C
AH 36 DH 36 EH 36	C 0.18, Mn 0.90-1.60 Si : 0.50 max S 0.035, P 0.035, Nb 0.02-0.05 V 0.05-0.10, Ti 0.02 max	YS 355 MPa UTS 490-620 MPa Imp AH 36 34 J min at 0°C DH 36 34 J min at -20°C EH 36 34 J min at -40°C

Mechanical Properties

Processing of plate orders for Home Sales through Vacuum Degassing (VD)/Isothermal/normal route as per customer requirements.

Requirement			Process		
Category	Grade	Specifications/ Sub Grades	Vacuum Degassing (VD) (Ref. A20/A20 M:07 CI 5.3.4 & S1)	Isothermal (Ref. A20/A20 M:07 CI 5.3.4)	Normal
UT	Mild	IS 2062 E 250 A, B, C, A/SA 283 A/SA 36, BS4360 Gr 43A, BS/DIN EN 10025 S235, 275 JIS G 3101 SS 400, DIN 17100 RSt 37.2, 44.2 Other Equivalent grades	≥ 50 mm All grades with UT	40 to <50 mm All grades with UT	<40 mm All grades
	Boiler Quality (Normal strength)	IS 2002/1,2,3, IS2041/1,2 A/SA 515 & 516 Grades A/SA 285	≥ 50 mm	40 to <50 mm	<40 mm
		DIN 17155 HI, EN 10028 2-P 235 GH, P265GH, EN 10028-2-P275	All thickness	–	–
	Boiler Quality (High Strength)	BS 1501-1 BS EN 10028-2-P295GH & 355GH BS EN 10028-3-P355	All thickness	–	–
		A/SA 537 Class 1, IS2041/3	≥ 50 mm	40 to <50 mm	<40 mm
	Boiler Qty. (Spl)	A/SA 204, SAIL FRS	All thickness	–	–
	High Tensile	IS 2062 E 300, 350, 410 Sailma 300, 300HI/350, 350HI/410, 410HI ASTM A 572 Gr 42, 50, DIN 17100 St 52.3 BS/DIN EN S355 JO, JR, J2, NL GOST 9G2S, 10G2S1, BS4360 Gr 50	≥ 50 mm	40 to <50 mm	<40 mm
Special	API, DMR, SAIL HITEN, SAILHARD, SAILMA 450 550, 600 SAILMA 450HI 550HI, 600HI, HT 750 IS 2062 E 450 D, E A 588, A 242, GOST5521 Hot Saw Disc	All thickness			
UT	All grades	All specifications/ Sub grades	≥ 50 mm	40 to <50 mm	<40 mm
IMPACT	All grades	All specifications/ Sub grades	Impact test tempe- rature lower than (–) 20°C		
SPL TDC	All grades	All specifications/ sub grades	As per Customer's requirement or agreement		
Normalised Plate	As per mandatory requirement of the specification or as per agreed TDC				
Normalised Rolling	As per requirement of the customer				